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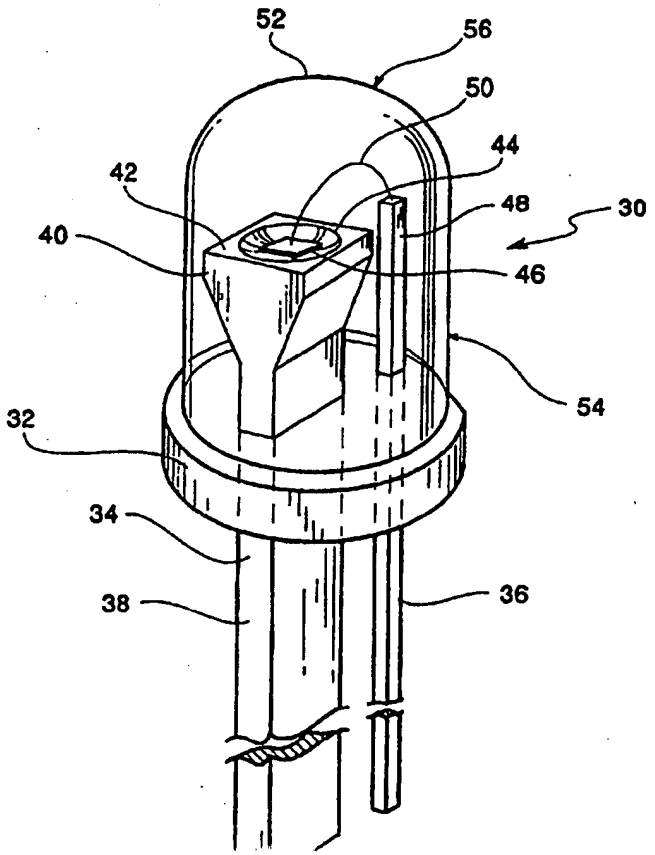
(54) Title: LED ASSEMBLY WITH ENHANCED POWER OUTPUT

(57) Abstract

The remote control includes a light emitting diode assembly (30) having enhanced power output. The diode assembly (30) comprises: a non-electrically conductive base (32); an elongate cathode lead (34) having a proximal portion (38), a distal portion (40) and a distal end (42), the proximal portion (38) having a first cross section and the distal portion (40) having a second cross-section; a light emitting diode chip (46) mounted on the distal end (42) of the cathode lead (34); an anode lead (36) having a cross section less than the cross section of the cathode lead (34); and, a bond wire (50) connecting the anode lead (36) to the light emitting diode chip (46). The proximal portion (38) of the cathode lead (34) and the anode lead (36) are mounted in the base (32).



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LED ASSEMBLY WITH ENHANCED POWER OUTPUT

BACKGROUND OF THE INVENTION

1. Field of the Invention.

The present invention relates to a light emitting diode (LED) assembly which is designed for use in a remote control and which has enhanced power output. More specifically, the LED assembly includes a large cross section cathode lead on the end of which is mounted an light emitting diode chip. The cathode provides both electrical conduction and heat conduction for dissipating heat from the chip, i.e., it acts as a heat sink.

2. Description of the related art.

Heretofore, infrared (IR) light emitting diodes (LEDs) have been used in hand operated remote controls for many years to control consumer entertainment equipment. These hand held remote controls, such as the one described in the Darbee U.S. Patent No. 4,959,810, can be found in most living rooms and are increasingly finding their way into the lifestyle of the American family - controlling everything from entry into the family car to starting the washing machine.

As these hand held remote controls proliferate, more and more demands for excellence in performance are received from users. The performance improvements most often requested, are increases in the range at which the handset will control a given piece of equipment and wider control angles so the user need not point the handset accurately.

To achieve such performance increases, lenses and reflectors have been proposed, but the most viable technique available is to increase the infrared radiation from the light emitting diode. This can be achieved most easily by increasing the forward bias current through the diode. However, as diode forward current increases the diode chip dissipation also increases and it begins to heat up. Heating of the diode chip immediately causes the IR output to decrease and if allowed to continue, will eventually destroy the diode. If the heat can be removed from the chip at a fast enough rate, a stable operating point can be reached where high IR power output is achieved and the diode chip is not over-stressed.

Heretofore it has also been proposed in the nonanalogus laser art to provide heat sinks for laser light emitting

diodes. Several examples of the nonanalogus heat sink assemblies used in laser diode arrays are disclosed in the following nonanalogus U.S. Patents:

U.S.Patent No.	Patentee
4,952,019	Evans et al.
4,995,687	Nagai et al.
5,007,700	Albares
5,181,214	Berger et al.
5,195,102	Mc Lean et al.

As will be described in greater detail hereinafter, none of the prior art patents cited above disclose a light emitting diode assembly for use in a remote control where a light emitting diode chip is provided with a heat sink for conducting heat away from the light emitting diode chip thereby to enhance the power output and life of the diode chip. Furthermore, none of the prior art patents cited above disclose a light emitting diode assembly which includes a cathode lead having significant mass and cross-section and which mounts at the end thereof a light emitting diode chip with the cathode lead having significant mass and cross-section thereby to provide a heat sink mass for the diode chip.

SUMMARY OF THE INVENTION

According to the invention there is provided, in a hand held remote control which emits infrared light signals for controlling the operation of a device to be controlled, a light emitting diode assembly having enhanced power output. The diode assembly comprises: a non-electrically conductive base; an elongate cathode lead having a proximal portion, a distal portion and a distal end, the proximal portion having a first cross-section and the distal portion having a second cross section; a light emitting diode chip mounted on the distal end of the cathode lead; an anode lead having a cross-section less than the cross-section of the cathode lead; and, a bond wire connecting the anode lead to the LED diode chip. The proximal portion of the cathode lead and the anode lead are mounted in the base.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a remote control having one or more light emitting diodes constructed according to the teachings of the present invention.

FIG. 2 is an enlarged perspective view of a light emitting diode constructed according to the teachings of the present invention.

FIG. 3 is a side elevational view of the diode shown in FIG. 2 and is taken along line 3-3 of FIG. 2.

FIG. 4 is a side elevational view of the light emitting diode shown in FIG. 3 and is taken along line 4-4 of FIG. 3.

FIG. 5 is a top plan view of the light emitting diode of the present invention and is taken along line 5-5 of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, there is illustrated therein a remote control 10 which can be of the type disclosed in U.S. Patent No. 4,959,810, the disclosure of which is incorporated herein by reference.

The remote control 10 includes a key pad 12 having a plurality of keys thereon for operating the remote control 10. The remote control 10 is generally rectangular in shape and has a window 14 at one end 16. As shown, three light emitting diodes 21, 22 and 23 are mounted in the window 14.

Referring now to FIG. 2, at least one of (if not all) the diodes 21, 22 or 23 is a light emitting diode assembly 30 constructed according to the teachings of the present invention. The diode assembly 30 includes a non-electrically conductive base 32 mounting a cathode lead 34 and an anode lead 36. The cathode lead 34 has a proximal portion 38 with a first, generally rectangular cross section and a distal portion 40 with a second, varying and larger, generally rectangular cross section. The distal portion 40 flares or tapers outwardly to an outer distal end 42 having a cavity 44 formed therein. The cavity 44 has a smooth reflective surface and has a parabolic shape for reflecting infrared (IR) light in a wide area. A light emitting diode chip 46 is mounted in the cavity 44 as shown in FIG. 1.

The anode lead 36 also has a generally square cross section which is much smaller in area than the cross section of the cathode lead 34 and a distal end 48 thereof is connected by a bond wire 50 to the chip 46.

The proximal portion 38 of the cathode lead 34 has, in cross section, a length of 2.0 mm and a width of 1.0 mm and the distal portion 40 tapers to the distal end 42 which has, in cross section, a length of 2.0 mm and a width of 2.7 mm. The overall length of the cathode lead 34 is approximately 30 mm.

The cathode lead 34 is made of plated copper and, with the above dimensions, has a mass of approximately 5.6 grams. Typically the copper used has a mass of 8.96 gr/cm^3.

As shown in FIG's. 2-4, a transparent or translucent globe-shaped or bulb-shaped cover or envelope 52 is mounted on the base 32 over the distal ends 42 and 48 of the cathode and

anode leads 34 and 36, respectively. The cover 52 includes a generally cylindrical portion 54 which extends upwardly to a top, generally semi-spherical portion 56.

From the foregoing description, it will be apparent that the light emitting diode assembly 30 of the present invention has a number of advantages, some of which have been described above and others of which are inherent in the invention.

Also from the foregoing description it will be apparent that modifications can be made to the light emitting diode assembly 30 without departing from the teachings of the invention.

Accordingly the scope of the invention is only to be limited as necessitated by the accompanying claims.

CLAIMS

I Claim:

1. In a remote control of the type which emits infrared light signals for controlling the operation of a device to be controlled, an improved light emitting diode assembly having enhanced power output, said diode assembly comprising:

a non-electrically conductive base;

an elongate cathode lead having a proximal portion, a distal portion and a distal end, said proximal portion having a first cross-section and said distal portion having a second cross section;

said proximal portion being mounted in said base;

a light emitting diode chip mounted on said distal end of said cathode lead;

an anode lead mounted in said base and having a cross-section less than the cross-section of said cathode lead; and,

a bond wire connecting said anode lead to said diode chip.

2. The diode assembly of claim 1 wherein said distal end has a cavity therein in which said diode chip is mounted.

3. The diode assembly of claim 2 wherein said cavity has a reflective surface.

4. The diode assembly of claim 2 or 3 wherein said cavity has a parabolic shape.

5. The diode assembly of any of claims 1 to 4 further including a transparent or translucent cover received on said base and over said distal end of said cathode lead.

6. The diode assembly of claim 5 wherein said cover has a cylindrical portion mounted to said base and a hemispherical portion over said distal end of said cathode lead.

7. The diode assembly of any of claims 1 to 6 wherein said cathode lead distal portion flares outwardly from said proximal portion to said distal end.

8. The diode assembly of any of claims 1 to 7 wherein said second cross section of said cathode lead distal end portion is larger than said first cross section of said proximal portion.

9. The diode assembly of any of claims 1 to 8 wherein said second cross section of said cathode lead distal end is approximately 5.4 square millimeters.

10. The diode assembly of any of claims 1 to 9 wherein the

mass of said cathode lead is approximately 5.6 grams.

11. A light emitting diode assembly having enhanced power output, said diode assembly comprising:

a non-electrically conductive base;

an elongate cathode lead having a proximal portion, a distal portion and a distal end, said proximal portion having a first cross-section and said distal portion having a second cross section;

said proximal portion being mounted in said base;

a light emitting diode chip mounted on said distal end of said cathode lead;

an anode lead mounted in said base and having a cross-section less than the cross-section of said cathode lead; and,

a bond wire connecting said anode lead to said LED diode chip.

12. The diode assembly of claim 11 wherein said distal end has a cavity therein in which said diode chip is mounted.

13. The diode assembly of claim 12 wherein said cavity has a reflective surface.

14. The diode assembly of claim 12 or 13 wherein said cavity has a parabolic shape.

15. The diode assembly of any of claims 11, 12, 13 or 14 further including a transparent or translucent cover received on said base and over said distal end of said cathode lead.

16. The diode assembly of claim 15 wherein said cover has a cylindrical portion mounted to said base and a hemispherical portion over said distal end of said cathode lead.

17. The diode assembly of any of claims 11 to 16 wherein said cathode lead distal portion flares outwardly from said proximal portion to said distal end.

18. The diode assembly of any of claims 11 to 17 wherein said second cross section of said cathode lead distal end portion is larger than said first cross section of said proximal portion.

19. The diode assembly of any of claims 11 to 18 wherein said second cross section of said cathode lead distal end is approximately 5.4 square millimeters.

20. The diode assembly of claim 11 to 19 wherein the mass of said cathode lead is approximately 5.6 grams.

FIG. 1

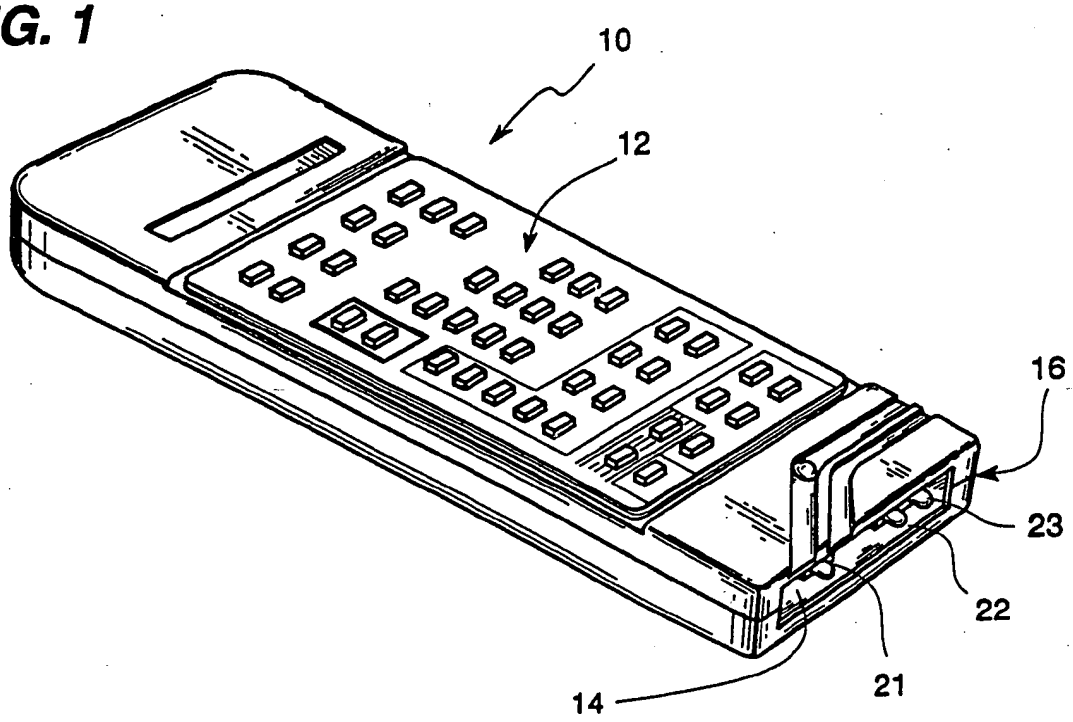


FIG. 2

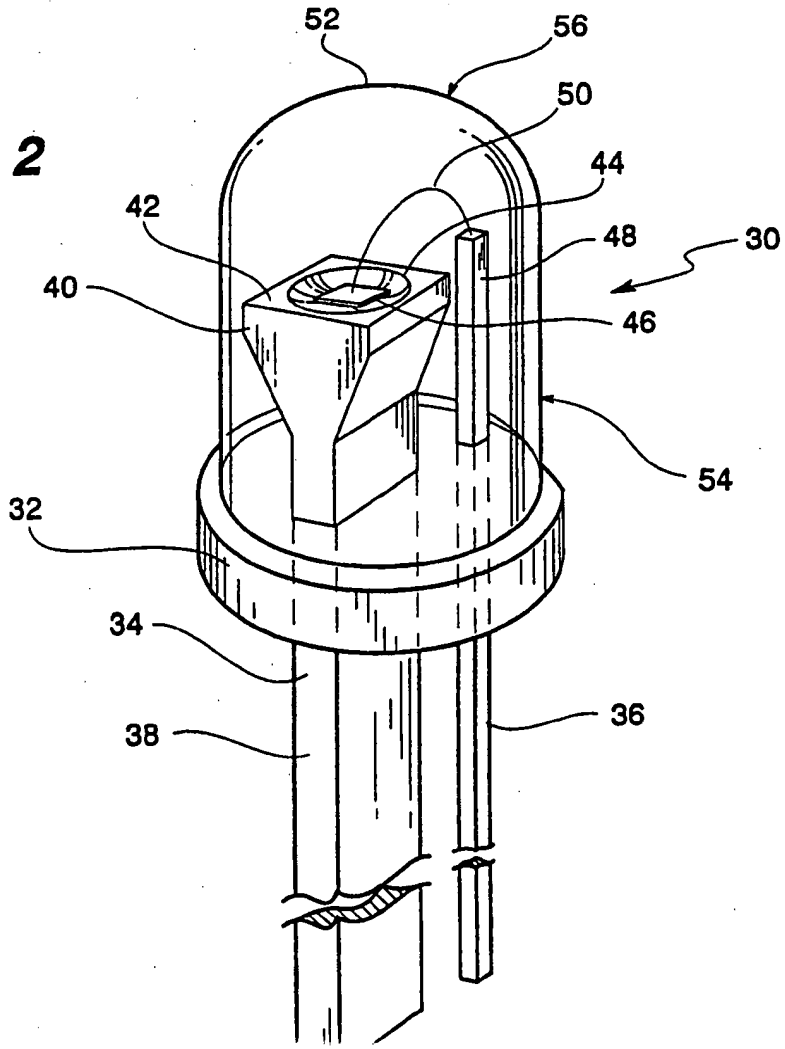


FIG. 3

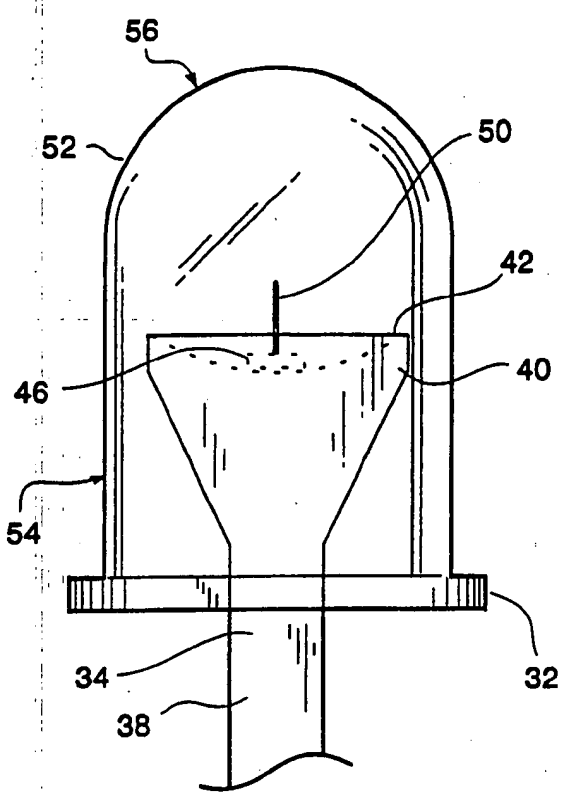


FIG. 4

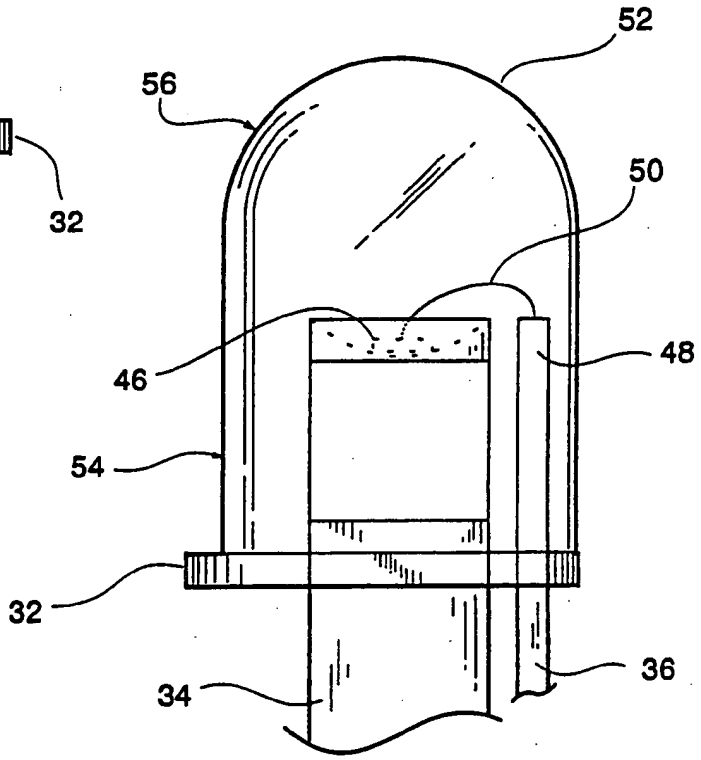
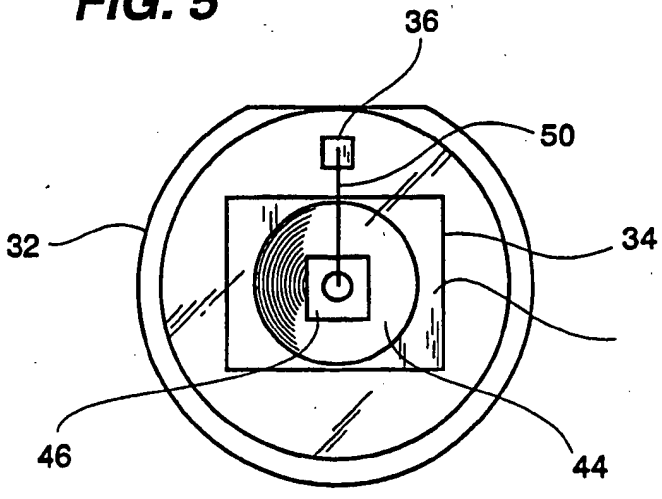


FIG. 5



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 94/10781

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H01L33/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,4 659 170 (JAMES P. WITTKE) 21 April 1987 see column 2, line 21 - line 32; figure 1	11
Y		1,2,5-8, 11,12, 15-18

Y	PATENT ABSTRACTS OF JAPAN vol. 10, no. 221 (E-424) 2 August 1986 & JP,A,61 056 472 (TOSHIBA CORP) 22 March 1986 see abstract	1,2,5-8, 11,12, 15-18

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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5 January 1995	24. 01. 95

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Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 11, no. 41 (E-478) (2488) 6 February 1987 & JP,A,61 207 085 (TOSHIBA CORP) 13 September 1986 see abstract	1,7,8, 11,17,18
A	PATENT ABSTRACTS OF JAPAN vol. 7, no. 158 (E-186) (1303) 12 July 1983 & JP,A,58 066 371 (TOKYO SHIBAURA DENKI K.K.) 20 April 1983 see abstract	1,7,8, 11,17,18
A	EP,A,0 456 343 (KULICKE AND SOFFA INDUSTRIES INC.) 13 November 1991 see column 3, line 43 - line 56; figure 3	1-5,8, 11-15,18

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US 94/10781

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-4659170	21-04-87	NONE	
EP-A-0456343	13-11-91	US-A- 5083192	21-01-92